Attachment B
Hydrogeomorphic (HGM) Classification

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The hydrogeomorphic (HGM) classification of wetlands was developed by the United States Army Corps of Engineers (USACE) Waterways Experiment Station (Brinson 1993). It is based on a wetland's (1) position in the landscape or geomorphic setting, (2) dominant source of water, and (3) hydrodynamics of the water in the wetland (Brinson 1993). The purpose of the HGM classification is to provide a mechanism to account for the inherent natural variation of wetlands, particularly when wetland functions are being assessed. For example, a riverine wetland will generally have a much higher ability to export organic carbon than a confined depressional wetland, based on the riverine wetland's landscape position and hydrodynamics.

In Alaska, HGM regional guidebooks are developed for Interior Alaska precipitation-driven (flat) HGM wetlands [Alaska Department of Environmental Conservation (ADEC) and USACE 1999], slope/flat HGM wetland complexes in the Cook Inlet Basin ecoregion (Hall et. al 2003), and riverine and slope HGM river proximal wetlands in coastal Southeast and Southcentral Alaska (Powell et. al 2003).

The HGM classification of the Donlin Gold Project (Project) Area is presented in the 2016 Preliminary Jurisdictional Determination (PJD) (Michael Baker 2016), which reports on the wetland and waters of the United States (WOUS) acres within the Project Area. HGM wetland classes identified in the Project Area include:

- Flat
- Depressional
- Estuarine (Coastal) Fringe
- Riverine
- Slope

HGM Descriptions

Flat (Organic Soil) Wetlands

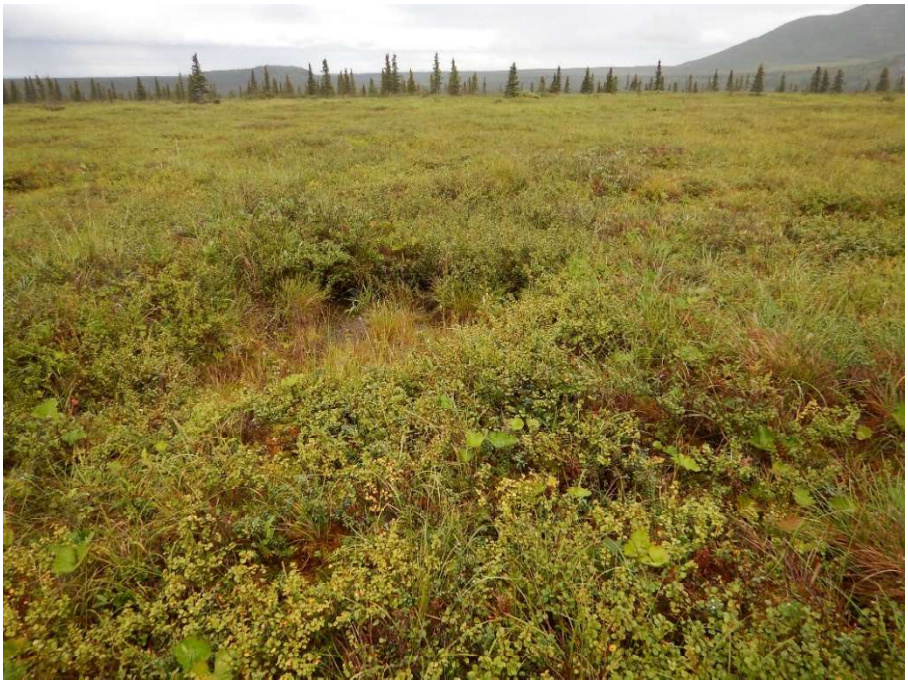
Flat wetlands are found in areas of high terrain located between valleys of adjacent waterways (interfluves), relic lake bottoms, and abandoned floodplain terraces above the zone of river flooding. The dominant water source is precipitation; flats are unique because they typically lack significant groundwater inputs. Flats can be further classified as mineral soil flat wetlands or organic soil flat wetlands based on the accumulation of organic matter. Organic soil flats differ from mineral soil flats, in part because their elevation and topography are controlled by vertical accretion of organic matter (Brinson et al. 1995). They occur commonly on flat interfluves, but also where depressions have become filled with peat to form a large level surface. Flats lose water by evapotranspiration, overland flow, and seepage to underlying groundwater. Flats are characterized by low lateral drainage, usually due to low hydraulic gradients (ADEC and USACE 1999).

In Alaska, flats cover vast areas where shallow permafrost tables hold precipitation at or near the surface. These flats can occur on sloping terrain, such as the millions of acres of tussock tundra dominated by tussock cotton-grass on the low, rolling hills of the North Slope region. Black spruce dominated hillside forests and woodlands in Interior Alaska are generally considered to be organic soil flat wetlands when permafrost occurs at a shallow depth. Large, flat wetlands also can be found on glacial outwash terraces and in parts of valley bottoms characterized by broad, shallow basins not exhibiting lateral water movement (ADEC and USACE 1999).

Flat HGM wetlands in the Project Area are almost exclusively organic soil flats. Vertical fluctuations are the dominant hydrodynamic in flat HGM wetlands. Photo 1 and Photo 2 are examples of flat HGM wetlands.

Photo 1 *Black Spruce Flat (Organic Soil) HGM Wetland on Hillside, Mine Site, Crooked Creek Watershed*

Photo 2 Low Shrub Tundra Flat (Organic Soil) HGM Wetland, Lower South Fork Kuskokwim River Watershed



Depressional Wetlands

Depressional wetlands occur where water accumulates in depressions; they occur on geomorphic surfaces with closed elevation contours. Depressional wetlands can have a variety of inlets and/or outlets or can lack them completely. Water sources include precipitation, groundwater discharge, inlets and surface flow, and interflow from neighboring uplands. Typically, water flows toward the center of the depressional wetland from surrounding upland areas. Seasonal vertical fluctuation is the primary dominant hydrodynamic. Depressional wetlands lose water from an outlet (temporary and permanent), evapotranspiration, or vertical movement to deeper groundwater (ADEC and USACE 1999).

Depressional HGM wetlands occur as small bog or pond features embedded within large flat wetlands dominated by scrub black spruce. In the Project Area, they are evenly spaced, small shallow depressional features on terraces adjacent to Crooked Creek and other waters. Photo 3 and Photo 4 are examples of depressional wetlands.

Photo 3 Wet Herbaceous Depressional HGM Wetland, Headwaters Tatlawiksuk River Watershed

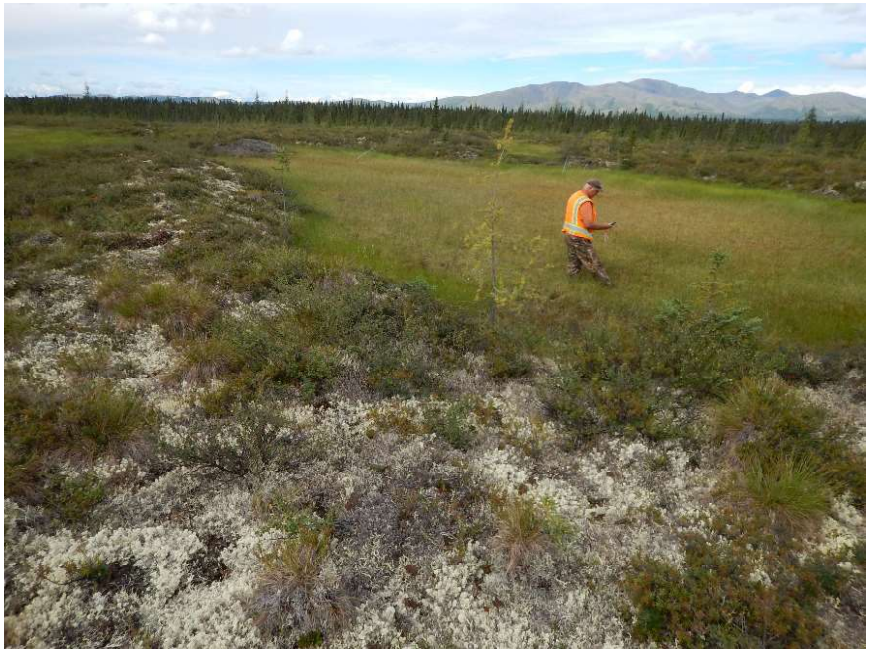
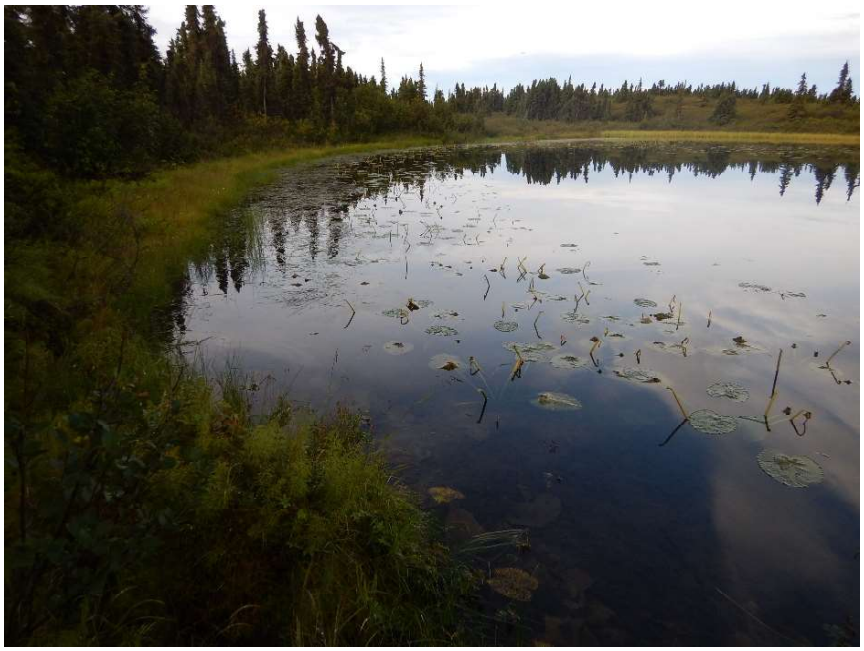


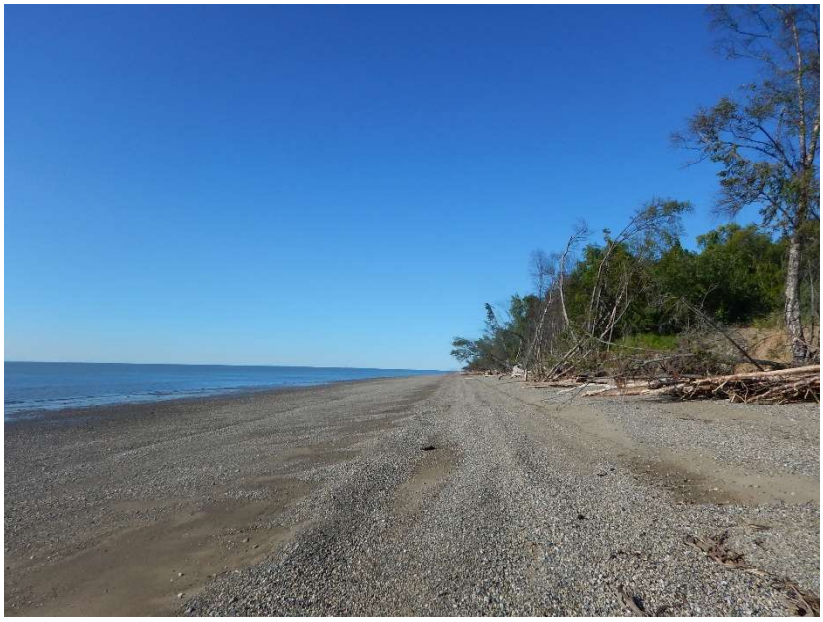
Photo 4 Open Water Depressional HGM Wetland, Middle Big River Watershed



Estuarine (Coastal) Fringe Waters

Estuarine fringe wetlands are found along ocean or sea coastlines and in estuaries. The dominant source of water is bi-directional flow from tides, either through flooding or groundwater. Additional inputs can come from groundwater and precipitation. Water loss in estuarine fringe wetlands comes from tidal exchange, overland flow, or evapotranspiration. Organic matter can accumulate in the absence of erosive forces (ADEC and USACE 1999). Photo 5 shows a coastal fringe HGM wetland.

Photo 5 *Open Water Coastal Fringe HGM Wetland, Old Tyonek Creek – Frontal Cook Inlet Watershed*



Riverine Wetlands

Riverine wetlands are found within active floodplains and along the banks of river and stream channels (riparian corridors). Dominant water sources are subsurface hydraulic connections or overbank flow from nearby river and stream channels and wetlands. Groundwater discharge from surficial aquifers, overland flow from neighboring uplands and small tributaries, and precipitation may contribute additional inputs. Riverine wetlands lose surface water by flow returning to the channel after flooding or precipitation events. Subsurface water loss generally occurs through discharge to nearby active channels, evapotranspiration, and vertical migration to deeper groundwater (ADEC and USACE 1999).

In Alaska, riverine wetlands range from broad floodplains along large meandering river channels, such as the Yukon, Tanana, and Kuskokwim Rivers, to narrow, temporarily flooded zones bordering higher gradient rivers and streams. Extremely large riverine wetland complexes are found on deltas, such as the Yukon-Kuskokwim Delta, the Copper River Delta, and the Stikine River Delta.

Photo 6 and Photo 7 are examples of riverine HGM wetlands.

Photo 6 *Wet Herbaceous Riverine HGM Wetland, Johnson Creek Watershed*

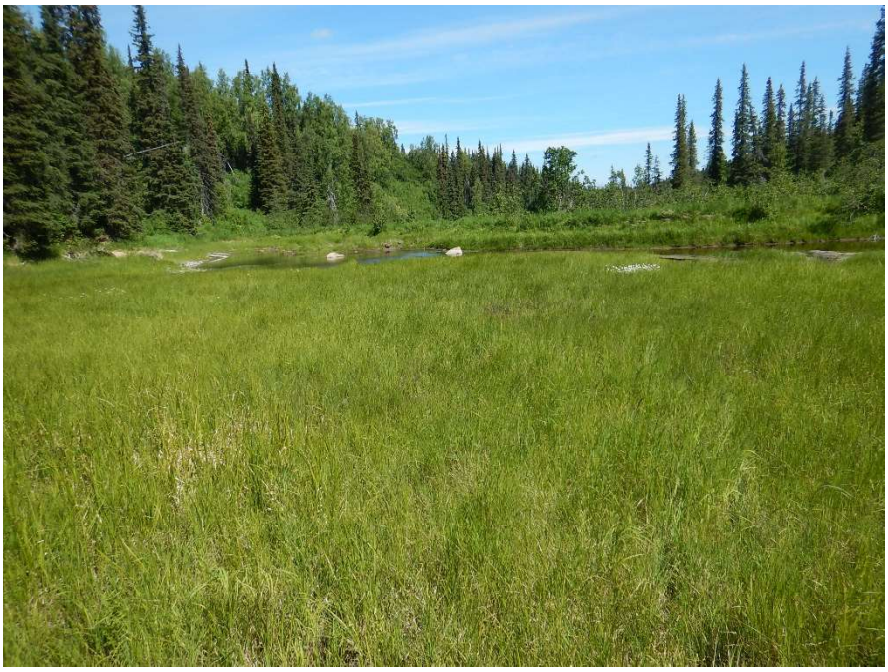
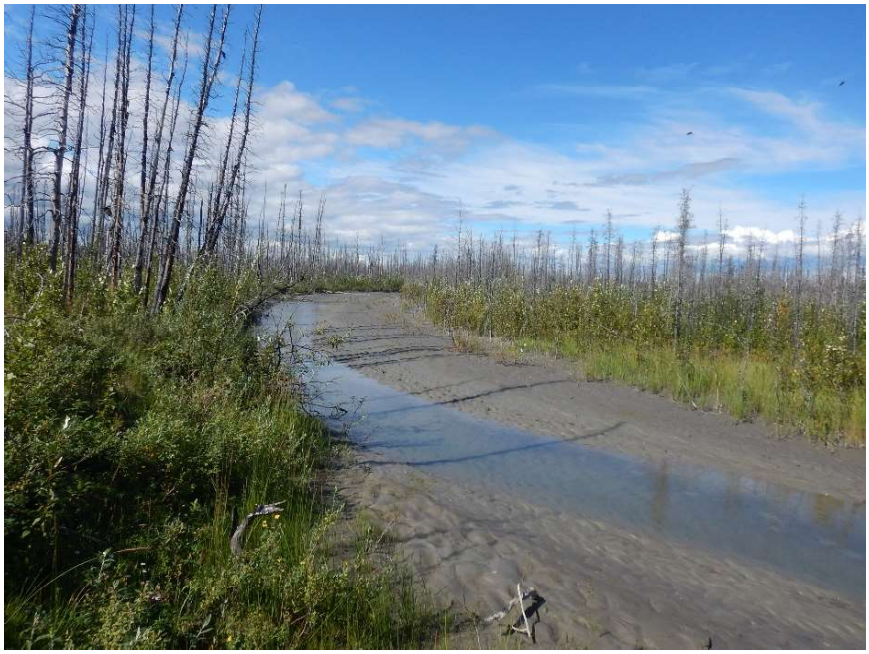


Photo 7 *Open Willow Shrub Riverine HGM Wetland, Middle South Fork Kuskokwim River Watershed*



Slope Wetlands

Slope wetlands are usually dominated by scrub black spruce with an understory of ericaceous shrubs and a dense mat of sphagnum moss. Black spruce forested wetlands are found at the base of slopes where hillsides become wetter. The Cowardin functional class includes both stunted scrub and full-size trees. Slope HGM wetlands include patterned fens, hillside seeps, spring-fed wetlands, and wetlands at the base of bluffs or hills where groundwater is discharged near the surface, and also includes flooded bottomland slope wetlands and string bogs in the Cook Inlet Basin. Slope HGM wetlands have downslope, unidirectional flow of water.

Slope wetlands are normally found where groundwater is discharged to the surface (ADEC and USACE 1999). They occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Slope wetlands are usually incapable of water storage because they lack closed contours. Principal water sources are usually groundwater return flow and interflow from surrounding uplands, as well as precipitation. Hydrodynamics are dominated by downslope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is present. Slope wetlands lose water through subsurface saturation and surface flows, and through evapotranspiration.

Photo 8 and Photo 9 are examples of slope HGM wetlands.

Photo 8 Open Willow Shrub Slope HGM Wetland, Happy River Watershed

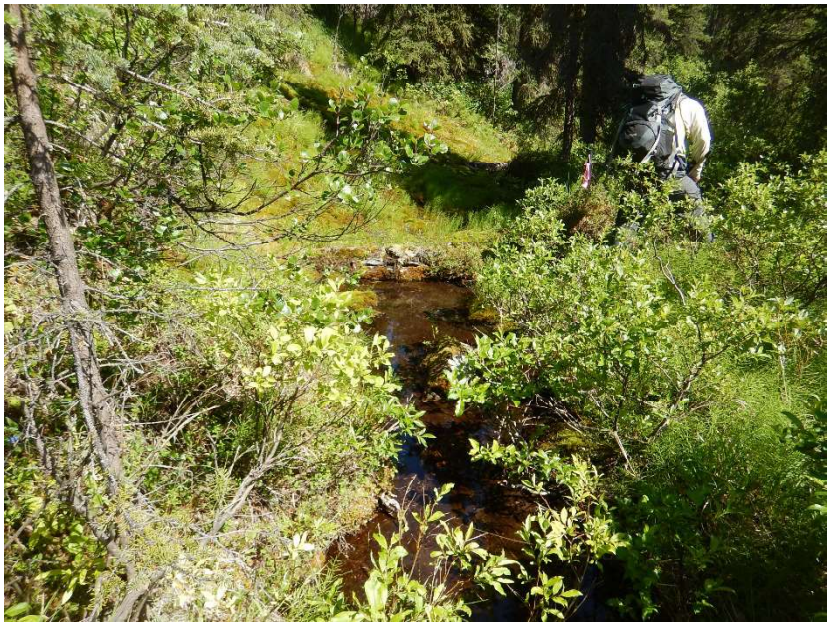
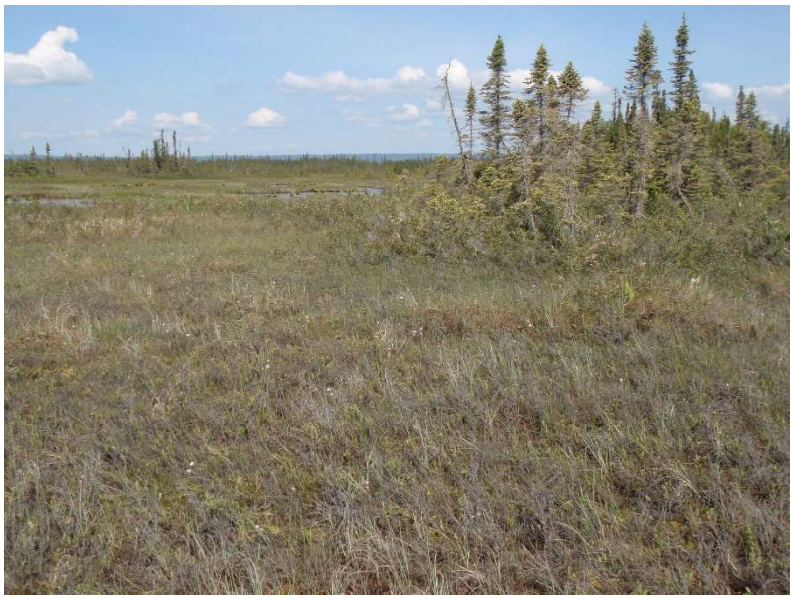


Photo 9 Ericaceous Bog – String Bog, Slope HGM Wetland, Beluga River Watershed



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